Physics and Chemistry of the Earth 105 (2018) 1–2

Contents lists available at ScienceDirect

Physics and Chemistry of the Earth

journal homepage: www.elsevier.com/locate/pce

Editorial

# Innovative solutions for intractable water problems in the face of climate change in southern and East African sub regions

## 1. Introduction

This issue has a total of thirty-two (32) papers; and covers the IWRM sub themes of Hydrology, Land and People, Water Resources Management, Water and Environment and Wastewater and Sanitation. Water issues have become more and more complex as the supply side is affected by issues of quantity, availability and vulnerability due to natural factors such as climate change and urbanization. These challenges call for new management strategies and governance styles. Access to clean freshwater is a basic requirement for enhanced quality of life and development by all. However, this access has three main components that must be met adequately as this issue illustrates. These components are firstly, the quantity of water available; secondly, the quality and thirdly supply and appropriate delivery of this precious resource to domestic, commercial and industrial users. The demand side has also become more challenging, especially in urban areas as more and more people move from the rural areas to the cities. It has become a daily challenge in many African cities to supply water to these new urban dwellers and more so in unplanned settlements. These issues require a way and manner of delivering solutions and new innovative ideas. The topics in this issue vary from climate variability and how we are to improve our management strategies to mitigation, through to vulnerability of water resources and how to strengthen governance issues that plague some institutions in our region.

## 2. Hydrology

The theme was dominated by papers contributing towards our understanding of the response of hydrological cycle components due to various stressors such as climate change and variability and human activities, using both in-situ (station observed) and alternative data sources such as Remote Sensing (Dube et al., Lekula et al., in this volume). Studies also included those on techniques for tracking the spatial and temporal progression of floods and droughts (e.g. Bykataondat et al. and Pandey et al.) which help us to monitor floods closely and reduce their disruptive nature on marginal societies. In addition, highlights on the role of urbanization (due to rapid demographic changes) and climate change on the present and future climate regimes are discussed in some fine detail to illustrate their impacts on urban societies such as Addis Abbaba, Ethiopia. The study by Tsidu et al. found that there will be increases in the future temperatures and rainfall, posing considerable challenges in water resource use and management. Similarly, Moses and Hambira found an intensification of the evapotranspiration regime of the Okavango Delta in Botswana attributed to changes in the climatic regime.

The theme had some contributions on the application and assessment of hydrological and related models to support catchment level decision making. In their quantification of water resources uncertainties in the Luvuvhu sub-basin of the Limpopo River basin, Oosthuizen et al. applied the Pitman model where they found that the ability of the model was more uncertain when water use data such as reservoirs and irrigation were included. A similar finding on considerable model uncertainty was found by Thavhana et al. in the Limpopo basin where the Soil and water Assessment Tool (SWAT) model was applied. Mabhaudhi et al. modelled the response of Bambara groundnut to climate change which showed that the crop has potential to withstand enhanced drought conditions with enhanced temperatures and even increase yield. These studies however demonstrate the importance of assessing model outputs before they can inform decision making.

## 3. Land and people

A less studied subject in water resources management is the impact of urbanization on the local climate. Tsidu et al. (2017) showed that urbanization of Addis Ababa increased the minimum temperature by 1.5 °C. Future climate change is expected to increase temperature during the dry season by 2.5–3.2 °C by 2050 and 2080 respectively. Such forecasting has been shown to require a strong historical data base of observational data. Without such data, forecasting becomes more complex and results not so definitive.

## 4. Water resources management

This theme contains six papers with a wide range of focus on issues related to water resources management. The areas covered under the theme include drought impacts on maize productivity, impacts of land use on water quality, stakeholder participation in water management, analysis of water institutions and entitlements and water resources planning.

The increasing competition for access to water necessitates more efficient water laws that promote equitable allocation of water and efficient use of the resource. Most of the countries in the southern African region have introduced or improved laws to govern water use. The efficiency of implementing these water sector reforms may need to be investigated for each country. In Botswana, for instance, Mogomotsi highlights that, even with the recent reforms, the country needs to

https://doi.org/10.1016/j.pce.2018.05.010

Available online 24 May 2018
1474-7065/ © 2018 Published by Elsevier Ltd.

balance social and environmental water resource needs through water policies and other statutory enactments, as well as the crafting of practical management strategies. Kapangaziwiri et al. investigated lawful water use in KwaZulu Natal Province of South Africa. Their findings highlighted the need to regularly update national water use databases as 40% of the identified water users were either illegal or unregistered.

Increasing populations in the sub-Saharan region has seen a significant change in land uses as more land is opened up for habitation or food production. This is being witnessed in urban areas as well as in rural areas. The resultant changes in land use and land cover affect stream flows and water quality. Namugize et al. studied the effects of changes in land use and land cover on water quality in the Umgeni catchment of South Africa. Their findings show that urbanization appears to be the largest contributing factor on pollution of water bodies with dams resultantly acting as sinks of pollution. They also emphasise the need for more frequent and efficient monitoring of water quality if this deterioration in water quality is to be contained. Fears of climate change and its impacts continue to haunt water resources management. Masupha et al. acknowledged the increasing challenges that will be caused by dry spells, especially given the prediction that increased magnitudes and frequencies of droughts will be witnessed in the southern Africa region due to climate change (Nam et al., 2017). Their research on possible impacts of future droughts on maize production led to the development of a tool that can provide information to farmers to better cope with dry seasons. One of the traditional coping mechanisms against dry spells in agriculture is supplementary irrigation. However, irrigation schemes, particularly in smallholder settings are not performing satisfactorily (Moyo et al., 2017; Malano and Burton, 2001). Sharaunga and Mudhara investigated the determinants of farmers' participation in collective maintenance of irrigation infrastructure in KwaZulu-Natal Province of South Africa and concluded that participation of smallholder farmers in irrigation infrastructure maintenance has been a challenge in many developing countries leading to underperformance of irrigation schemes.

When everything is all said and done, it remains a fact that water resources systems are increasingly threatened by increasing competition for water, climate change and deteriorating water quality. Integrated water resources management is necessary to balance these conflicts. Effective scenario planning which employs cost-benefit analyses and accounts for all water sources and demands is therefore necessary as demonstrated by Gupta and Kumar at nine study sites in the Chirawa District of India.

## 5. Water and environment sub theme

The water and environment sub theme paper discusses techniques that have a potential for the removal of specific pollutants from the different water types for the benefit of society, agriculture and ecosystems. Among the discussed material are waste rock, tailings, coal ash clinker, and slag. These papers conclude on better candidates for the removal of specific metals from the waters. Use of nano technology to remove pollutants to improve both wastewater and portable water to better or even acceptable quality is also discussed in the papers. Also discussed by the sub theme papers are the complexity of pollutants within the micro-catchments as well as management challenges in the arid and semi-arid environments with special references to where safe and sustainable alternative sources are scarce. Therefore, an insight into possible hitches is advanced for decision-makers. One paper discusses groundwater salinization and seawater intrusion and concludes on sources of mineralization.

## References

Malano, H., Burton, M., 2001. Guidelines for Benchmarking Performance in the Irrigation and Drainage Sector. Food and Agriculture Organization of the United Nations, Rome.

Moyo, M., van Rooyen, A., Moyo, M., Chivenge, P., Bjornlund, H., 2017. Irrigation development in Zimbabwe: understanding productivity barriers and opportunities at Mkoba and Silalatshani irrigation schemes. Int. J. Water Resour. Dev. 33 (5) 2017.

Nam, W., Kim, T., Hong, E., Choi, J., 2017. Regional climate change impacts on irrigation vulnerable season shifts in agricultural water availability for South Korea. Water 2017 (9), 735. http://dx.doi.org/10.3390/w9100735.

Benjamin Mapani*
*University of Namibia, Faculty of Science, Department of Geology, Private Bag 13301, Windhoek, Namibia*
*E-mail address:* bmapani@unam.na

Hodson Makurira
*University of Zimbabwe, Faculty of Engineering, Department of Civil Engineering, P.O. Box MP 167, Harare, Zimbabwe*

Lapologang Magole
*University of Botswana, Department of Architecture and Planning, Faculty of Engineering, Private Bag UB 0061, Gaborone, Botswana*

Maideyi Meck
*University of Zimbabwe, Faculty of Science, Department of Geology, P.O. Box MP 167, Harare, Zimbabwe*

Theresa Mkandawire
*University of Malawi, The Polytechnic, Private Bag 303, Blantyre 3, Malawi*

Marloes Mul
*International Water Management Institute, PMB CT 112 Cantonments, Accra, Ghana*

Cosmo Ngongondo
*Department of Geography and Earth Sciences, Faculty of Science, University of Malawi, Chancellor College, P.O. Box 280, Zomba, Malawi*

* Corresponding author.